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Gasvoda

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(54) **SEALING MEMBER FOR A FLUID CONTAINER**

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/126,908**

(22) Filed: **Jul. 31, 1998**

(51) **Int. Cl.**[7] **B41J 2/175**; E03B 65/20
(52) **U.S. Cl.** **347/85**; 137/614.2
(58) **Field of Search** 347/85, 86, 87; 277/630, 634, 637, 644, 650; 141/329, 330, 2, 18; 137/614.2

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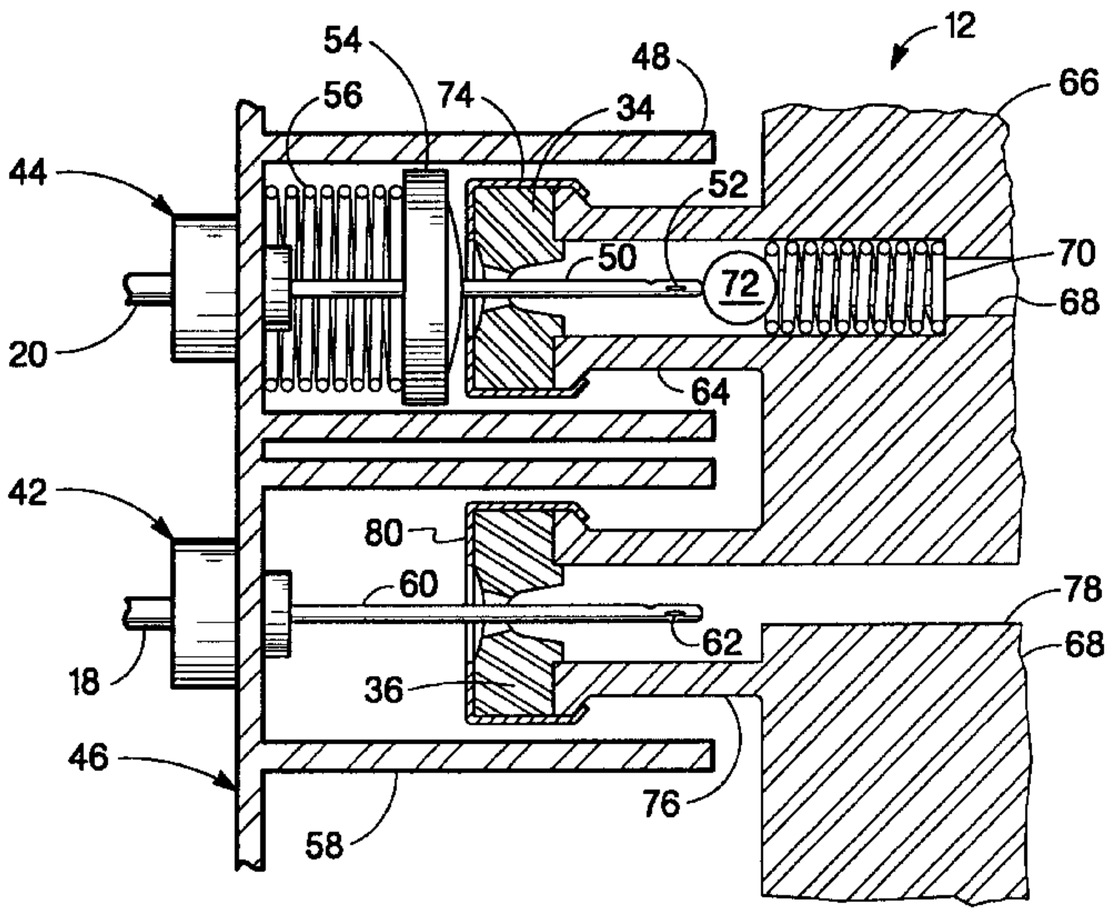
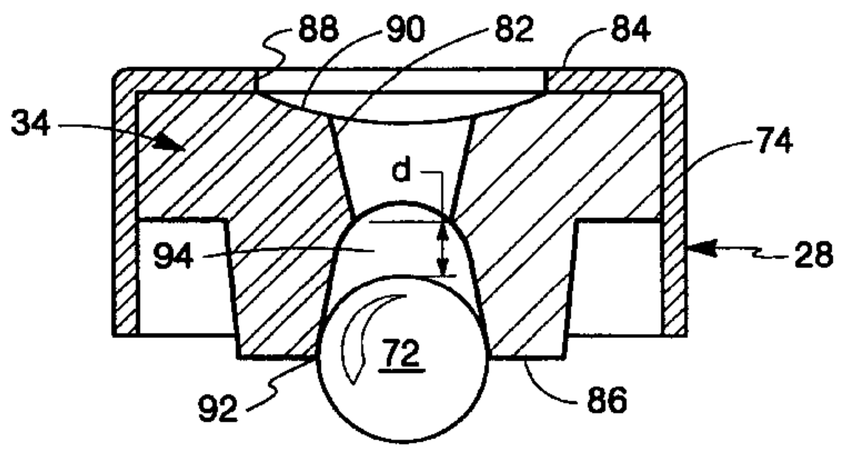
(74) *Attorney, Agent, or Firm*—Kevin B. Sullivan

(57) **ABSTRACT**

The present disclosure relates to a sealing member for sealing an opening in a fluid container. The sealing member receives a hollow tubular member to establish communication between the hollow tubular member and the fluid container. The sealing member includes a resilient sealing portion configured to receive the hollow tubular member. With the hollow tubular member inserted through the resilient sealing portion a compressive seal is formed with an outer surface of the hollow tubular member to limit passage of fluid between the resilient sealing portion and the hollow tubular member. Also included is a lead-in portion on the resilient sealing portion. The lead-in portion guides the hollow tubular member through the resilient sealing portion to establish communication between the hollow tubular member and the fluid container.

6 Claims, 5 Drawing Sheets





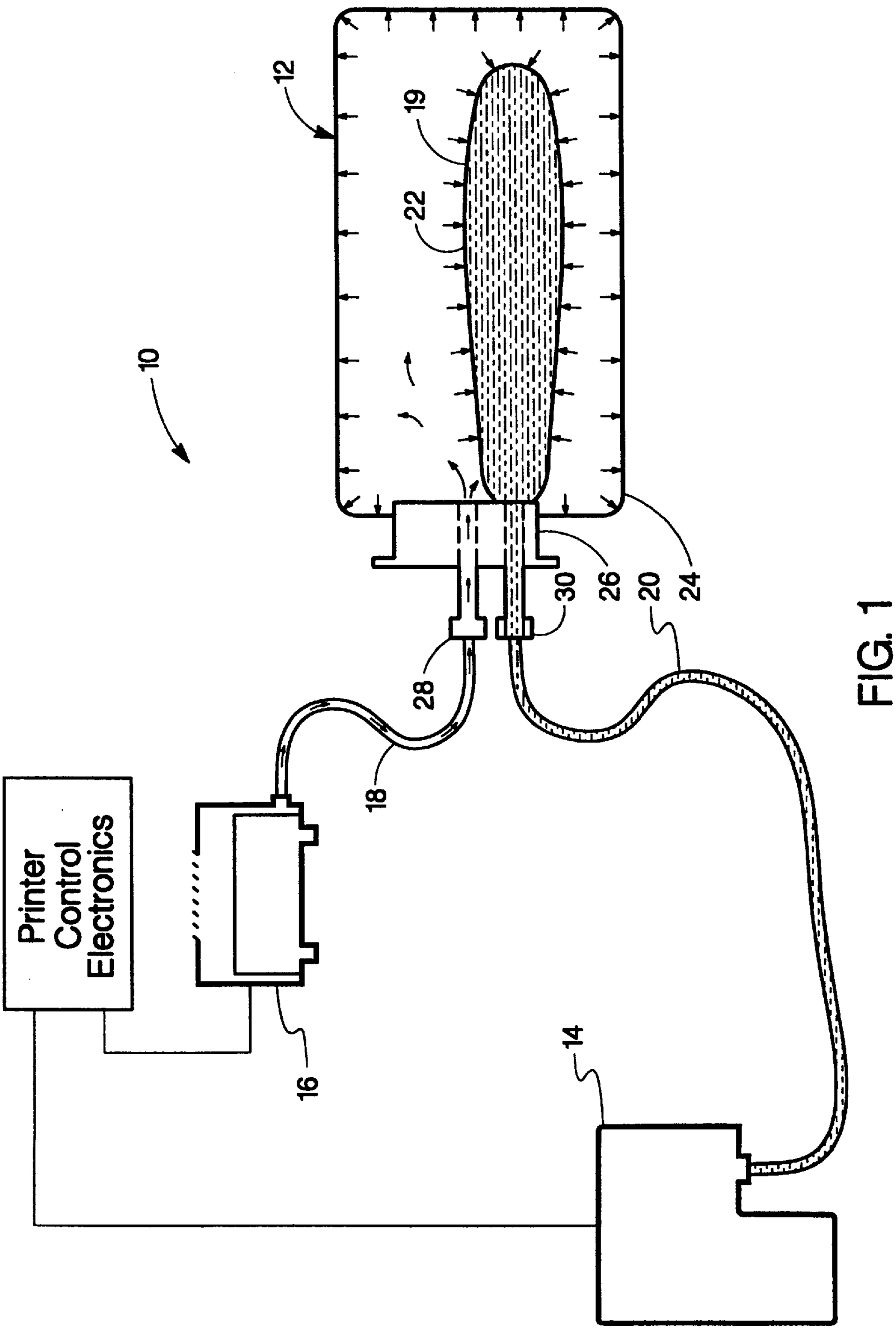


FIG. 1

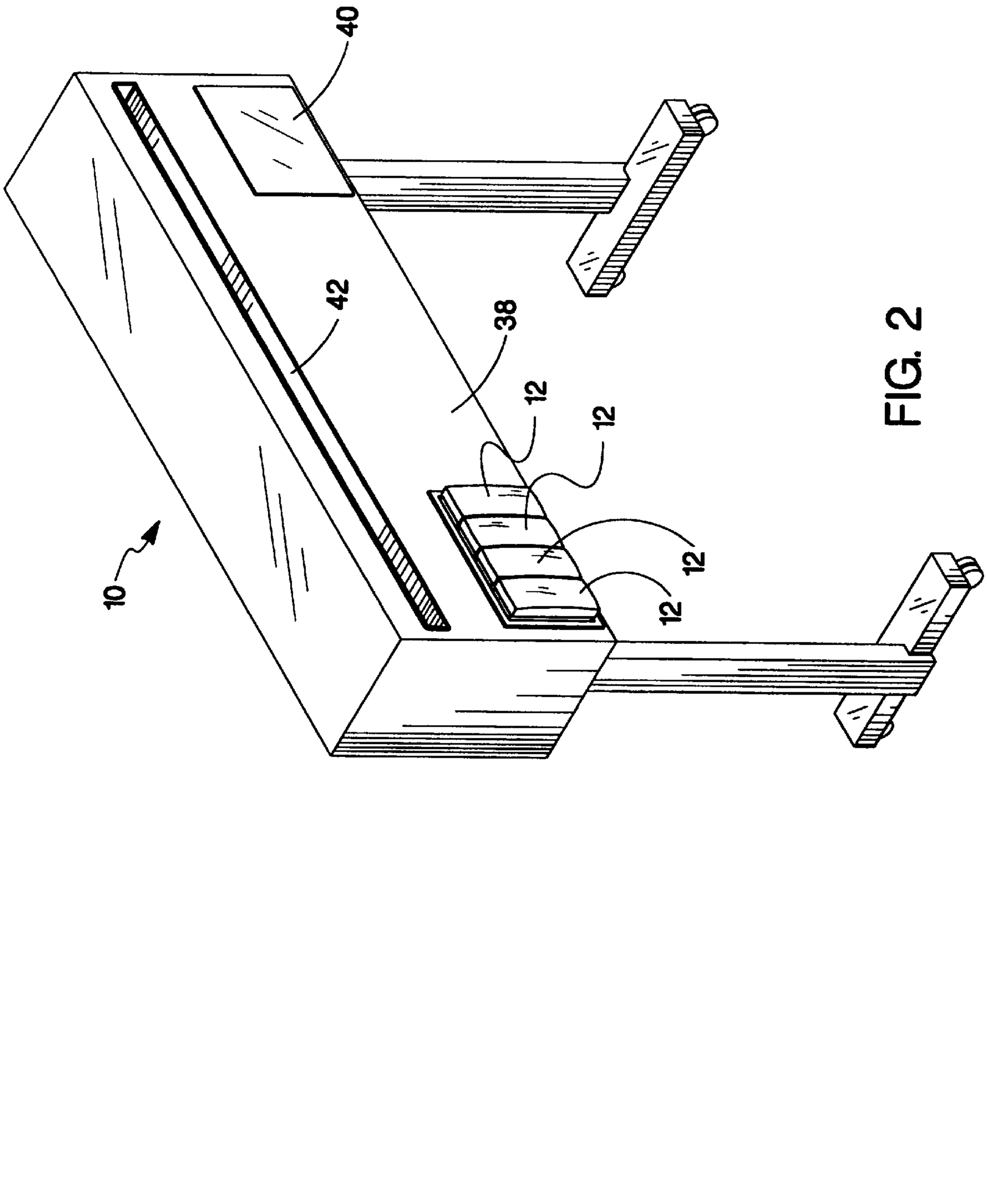


FIG. 2

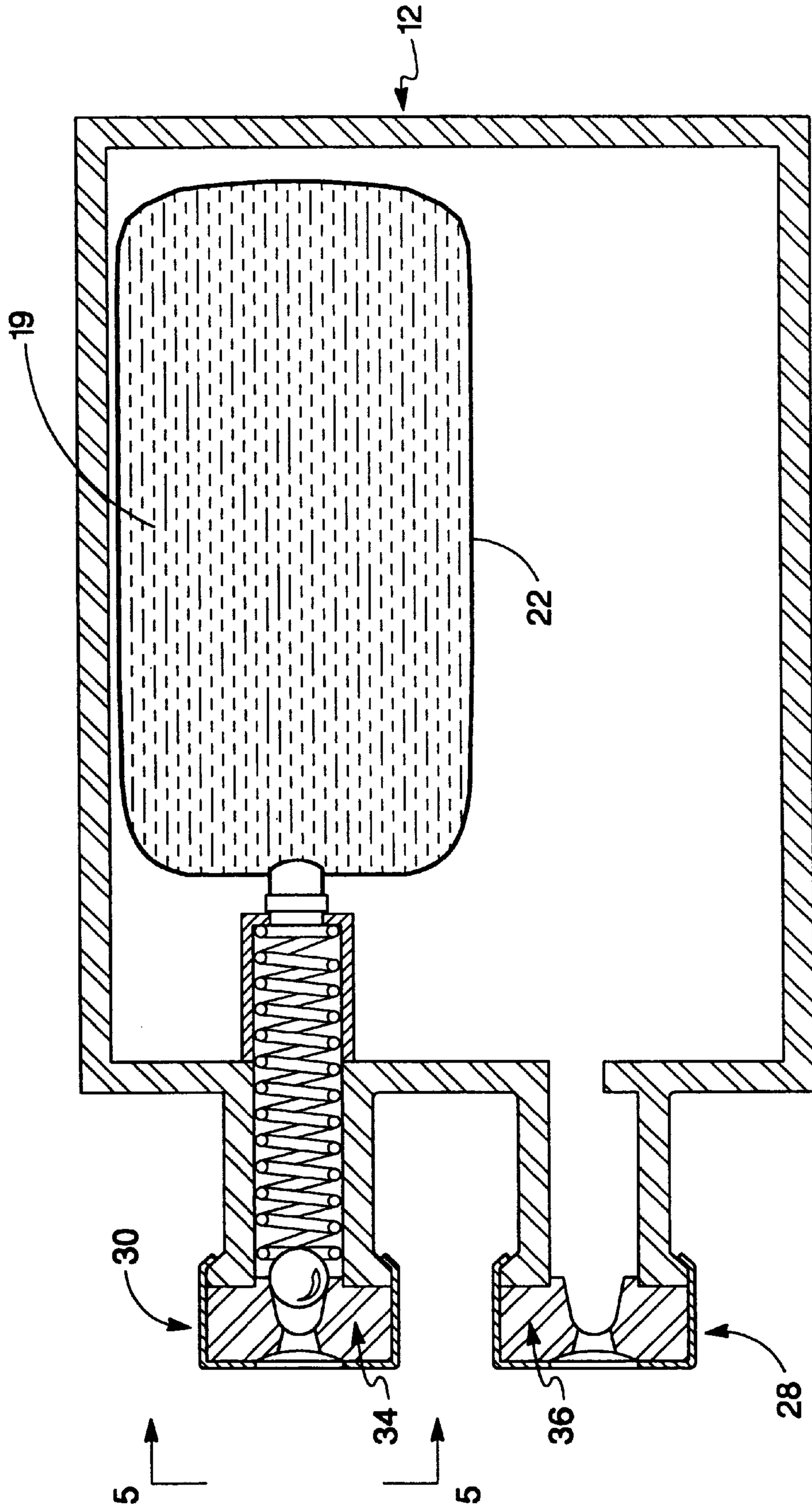


FIG. 3

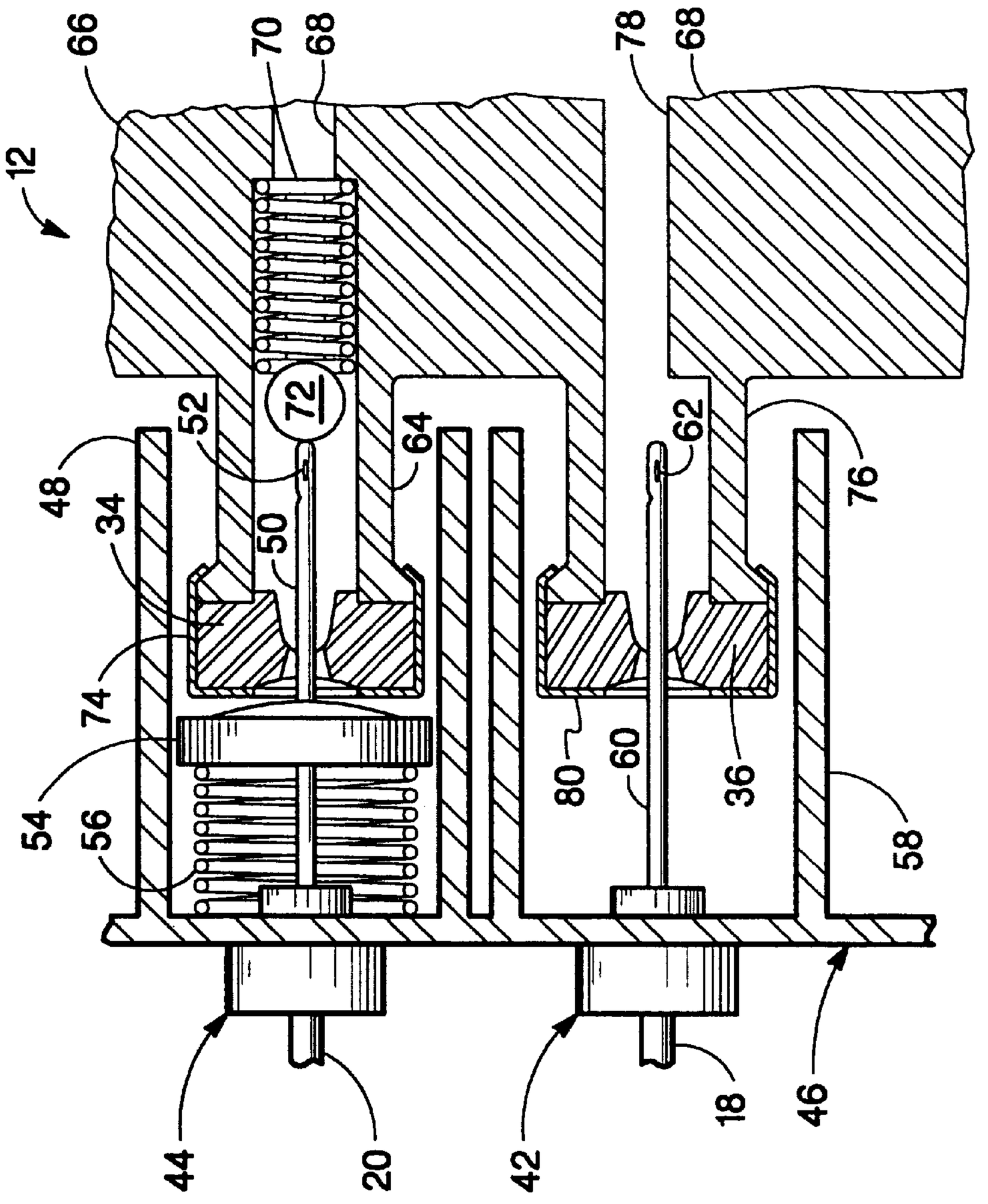

12
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FIG. 4

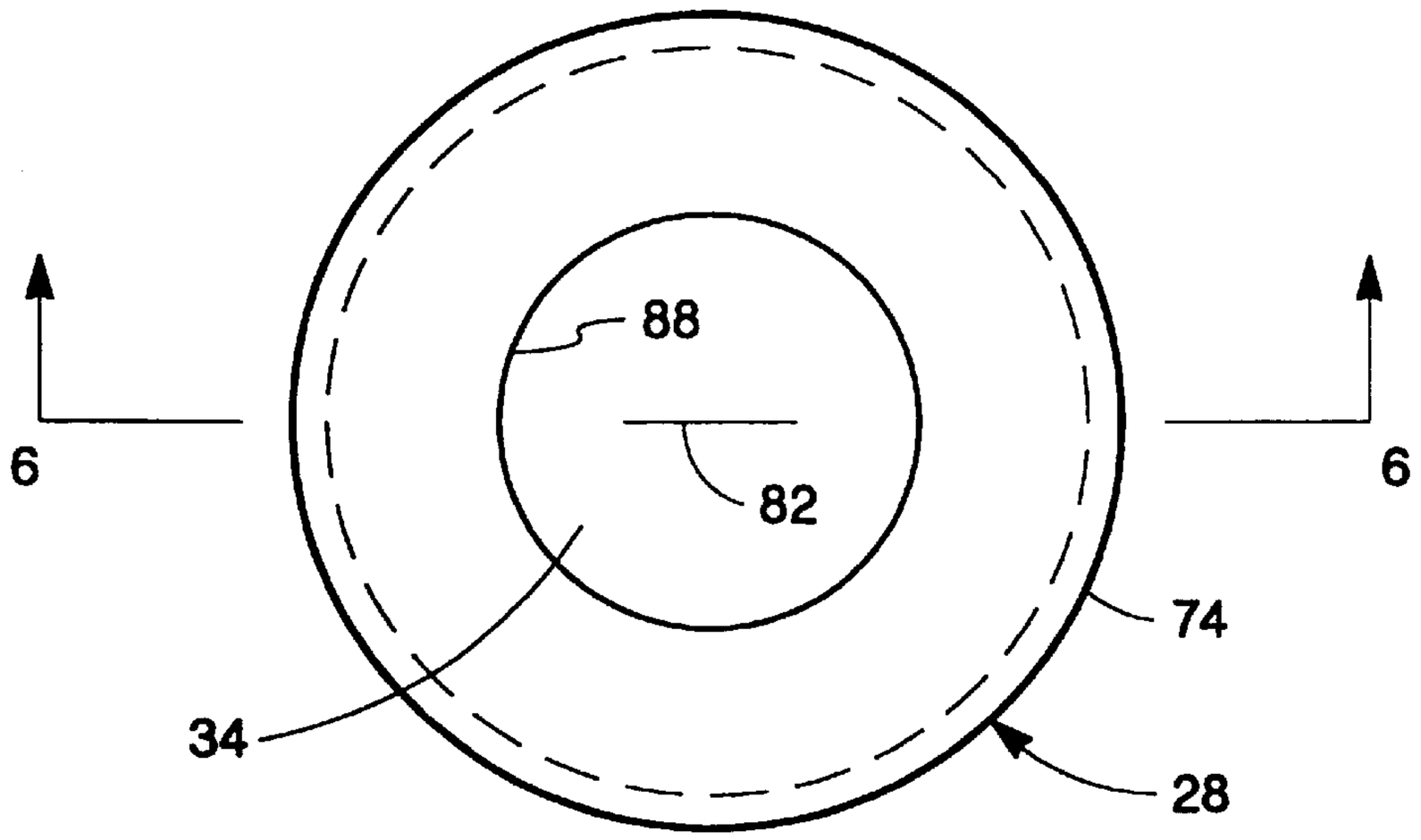

FIG. 5

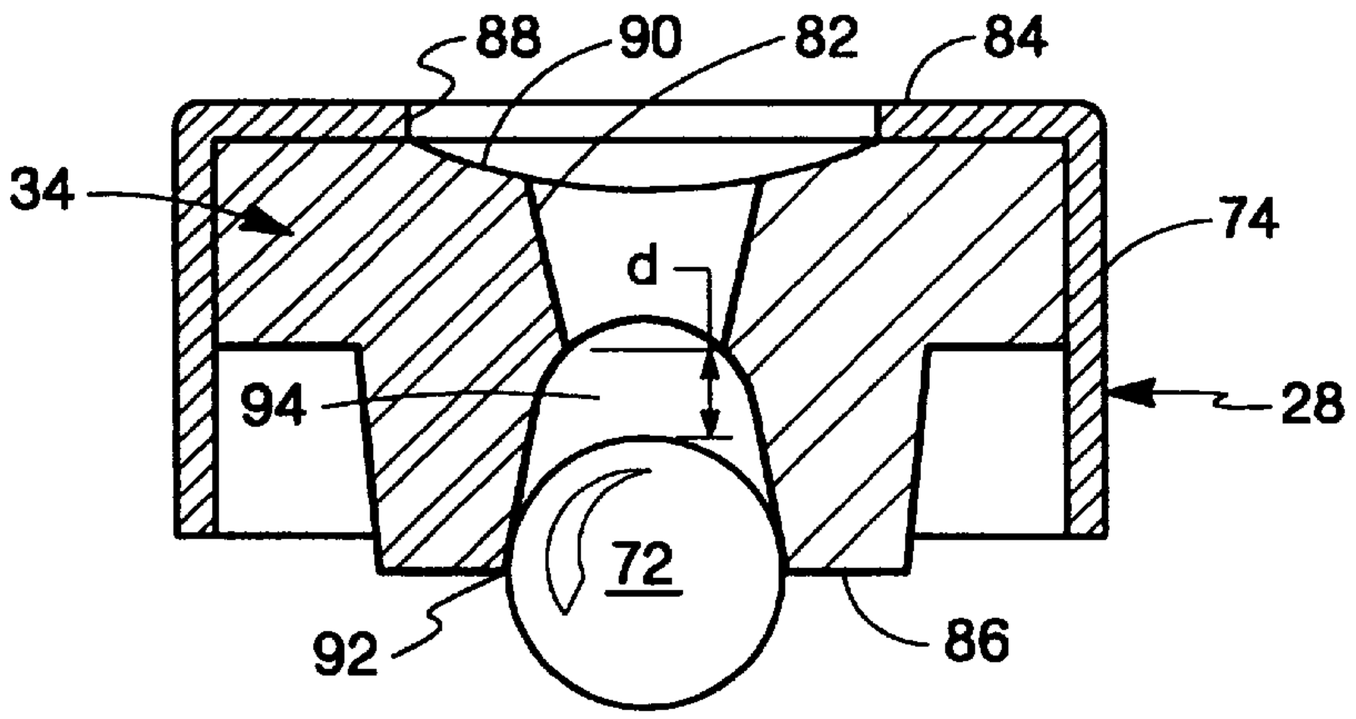

FIG. 6

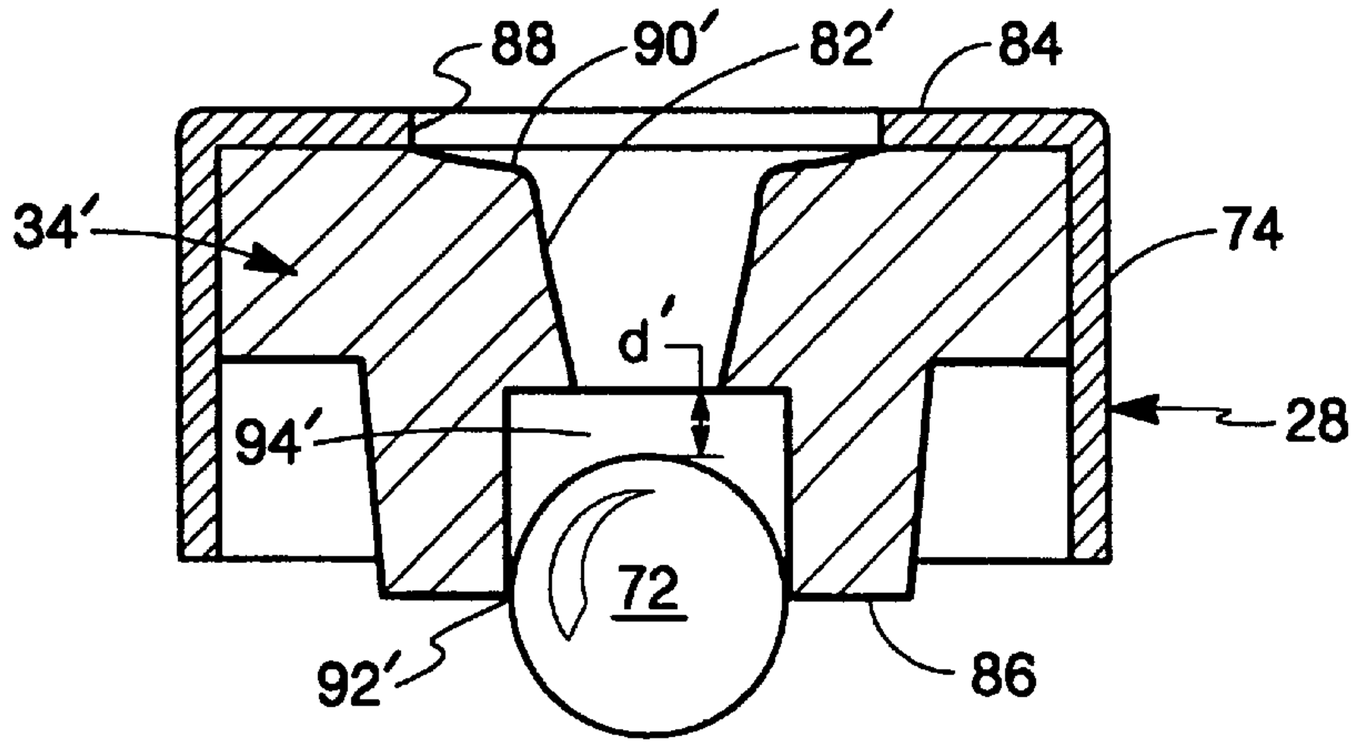

FIG. 7

SEALING MEMBER FOR A FLUID CONTAINER

BACKGROUND OF THE INVENTION

The present invention relates to ink-jet printing systems, and more particularly, ink-jet printing systems which make use of ink containers that are replaceable separate from a printhead.

Ink-jet printers frequently make use of an ink-jet printhead mounted to a carriage that is moved back and fourth across a print media, such as paper. As the printhead is moved across the print media, a control system activates the printhead to deposit ink droplets onto the print media to form images and text.

Previously used printers have made use of an ink container that is separably replaceable from the printhead. When the ink cartridge is exhausted the ink cartridge is removed and replaced with a new ink container. The uses of replaceable ink containers that are separate from the printhead allow users to replace the ink container without replacing the printhead. The printhead is then replaced at or near the end of printhead life and not when the ink container is exhausted.

There is an ever-present need for printing systems that are capable of providing low operating costs such as printers that make use of off-axis type ink supplies. In addition, these printing systems should be easy to operate, such as, including some form of memory for storing printing parameters so that the user is not required to adjust printer parameters when the ink container is replaced. These ink supplies should be capable of reliable insertion into the printing system to ensure that proper fluid interconnection and proper electrical interconnection with the printer is achieved. In addition, these interconnections should be reliable and should not degrade over time and use. For example, the fluid interconnect should not leak during use or over time and the electrical interconnect should be reliable during use and over time. In addition, these ink cartridges should not require special handling by the user and should be reliable and easily connected by the user to form a positive highly reliable mechanical, electrical, and fluid interconnect with the printer.

These ink containment systems should be capable of providing ink at high flow rates to a printhead thereby allowing high throughput printing. This ink supply system should be cost effective to allow relatively low cost per page printing. In addition, the ink supply should be capable of providing ink at high flow rates in a reliable manner to the printhead.

SUMMARY OF THE INVENTION

The present invention is a sealing member for sealing an opening in a fluid container. The sealing member receives a hollow tubular member to establish communication between the hollow tubular member and the fluid container. The sealing member includes a resilient sealing portion configured to receive the hollow tubular member. With the hollow tubular member inserted through the resilient sealing portion a compressive seal is formed with an outer surface of the hollow tubular member to limit passage of fluid between the resilient sealing portion and the hollow tubular member. Also included is a lead-in portion on the resilient sealing portion. The lead-in portion guides the hollow tubular member through the resilient sealing portion to establish communication between the hollow tubular member and the fluid container.

Another aspect of the present invention is an ink container for providing ink to an ink jet printing system. The ink jet printing system has a fluid inlet having a hollow needle that has a blunt end and a lateral hole. The ink container includes a first sealing surface for tightly receiving the hollow needle to prevent fluid passage between the hollow needle and the first sealing member when the ink container is in fluid communication with the ink jet printer. Also included is a second sealing surface for receiving a movable sealing member. The movable sealing member is biased against the second sealing member when the hollow needle is at least partially removed from the first sealing member. The second sealing surface is spaced sufficiently from the first sealing surface so that debris resulting from movement of the hollow needle relative to the first sealing surface does not prevent the movable sealing member from seating with the second sealing member. dr

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a schematic representation of a printing system that includes an ink container of the invention.

FIG. **2** depicts a perspective view of a representation of the printing system of FIG. **1**.

FIG. **3** depicts a representation of the ink container of FIG. **1** shown in section with the fluid out inlet shown greatly enlarged.

FIG. **4** depicts a cross section of a fluid outlet and an air inlet for the ink container of the present invention shown in engagement with a fluid inlet and air outlet, respectively associated with a printer portion.

FIG. **5** depicts an end view taken across lines **5**—**5** of the fluid outlet shown in FIG. **3**.

FIG. **6** depicts a section view of the fluid outlet shown in FIG. **5** taken across lines **6**—**6**.

FIG. **7** depicts a section view of an alternative embodiment of the fluid outlet shown in FIG. **6**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** depicts a schematic representation of a printing system **10** that includes the ink container **12** of the present invention. Also included in the printing device **10** are a printhead **14** and a source of pressurized gas such as a pump **16**. The pump **16** is connected by a conduit **18** for providing a pressurized gas such as air to the ink container **12**. A marking fluid **19** such as ink is provided by the ink container **12** to the printhead **14** by a conduit **20**. This marking fluid is ejected from the printhead **14** to accomplish printing.

The ink container **12** which is the subject of the present invention includes a fluid reservoir **22** for containing ink **19**, an outer shell **24**, and a chassis **26**. In the preferred embodiment the chassis **26** includes an air inlet **28** configured for connection to conduit **18** for pressurizing the outer shell **24** with air. A fluid outlet **30** is also included in the chassis **26**. The fluid outlet **30** is configured for connection to the conduit **20** for providing a fluid connection between the fluid reservoir **22** and fluid conduit **20**.

In the preferred embodiment the fluid reservoir **22** is formed from a flexible material such that pressurization of the outer shell produces a pressurized flow of ink from the fluid reservoir **22** through the conduit **20** to the printhead **14**. The use of a pressurized source of ink in the fluid reservoir **22** allows for a relatively high fluid flow rates from the fluid reservoir **22** to the printhead **14**. The use of high flow rates or high rates of ink delivery to the printhead make it possible for high throughput printing by the printing system **10**.

The present invention is a method and apparatus for forming a reliable fluid interconnection between the ink

container **12** and the printing system **10**. More specifically, the fluid outlet **30** associated with the ink container **12** allows for fluids to be transferred in a reliable manner between ink container **12** and the printhead **14**. In addition, the fluid outlet **30** also tends to prevent fluid from leaking from the from the ink container **12** when not connected to the printing system **10** such as during storage and transport. The fluid outlet **30** will be discussed in more detail with respect to FIGS. **3–7**. Before discussing the fluid outlet in detail the overall printing system will be discussed with respect to FIG. **2**.

FIG. **2** depicts one embodiment of the printing system **10** shown in perspective. The printing system **10** includes a printing chassis **38** containing one or more ink container **12** of the present invention. The embodiment shown in FIG. **2** is shown having four similar ink containers **12**. In this embodiment, each ink container contains a different ink color. Therefore, four color printing is accomplished by providing cyan, yellow, magenta and black ink from the four ink containers **12** to one or more printheads **14**. Also included in the printer chassis **38** is a control panel **40** for controlling operation of the printer **10** and a media slot **42** from which print media such as paper is ejected.

As ink **19** in each ink container **12** is exhausted the ink container **12** is replaced with a new ink container **12** containing a new supply of ink. In addition, the ink container **12** may be removed from the printer chassis **38** for reasons other than an out of ink condition such as changing inks for an application requiring different ink properties or for use on different media. It is important that the ink container **12** be not only accessible within the printing system **10** but also easily replaceable. It is also important that the replacement ink container **12** form reliable interconnects such as fluid interconnect, air interconnect and mechanical interconnect so that the printing system **10** performs reliably.

It is important that ink spillage and spattering be minimized to provide reliable interconnection between the ink container **12** and printer **10**. Ink spillage is objectionable not only for the operator of the printer who must handle the spattered ink container **12** but also from a printer reliability standpoint. Inks used in ink-jet printing frequently contain chemicals such as surfactants which if exposed to printer components can effect the reliability of these printer components. Therefore, ink spillage inside the printer can reduce the reliability of printer components thereby reducing the reliability of the printer.

FIG. **3** depicts a simplified representation of the ink container **12** of the present invention show in section and disconnected from the printing system **10**. The ink container **12** includes the fluid outlet **30**, shown greatly enlarged, which is in fluid communication with the fluid reservoir **22** containing the supply of fluid **19**. The ink container **12** further includes the air inlet **28** that is in communication with an area within the outer shell **24** and not within the fluid reservoir **22**. The application of a pressurized gas, such as air, to this region allows pressurization of the ink container **12** for providing a source of pressurized fluid from the fluid outlet **30**. The fluid outlet **30** and air inlet **28** of the present invention each include a sealing member **34** and **36** for sealing each of the fluid outlet **30** and air inlet **28**, respectively, when the ink container **12** is not installed in the printer chassis **38** shown in FIG. **2**. More specifically, the sealing member **34** prevents or limits ink leakage from the fluid outlet **30** when the ink container is not installed in the printer chassis **38**. In addition, each sealing member **34** and **36** provides a seal between the fluid outlet **30** and a fluid inlet (not shown) associated with the printer chassis **38** and a seal between the air inlet **28** and an air outlet (not shown) associated with the printer chassis **38**. The sealing members **34** and **36** tend to limit or prevent leakage of both air and ink when the ink container **12** is properly installed in the printer chassis **38**. The sealing members will be discussed in more detail with respect to FIGS. **4–7**.

FIG. **4** illustrates further detail of the preferred sealing member **34** and **36** associated with the fluid outlet **30** and air inlet **28**, respectively, of the ink container **12**. As shown in FIG. **4** the fluid outlet **30** and air inlet **28** is shown connected to a corresponding fluid inlet **44** and air outlet **42** associated with an ink container receiving station **46** on the printer chassis **38**.

In this preferred embodiment the fluid inlet **44** associated with the ink container receiving station **46** includes a housing **48** and outwardly extending needle **50** having a closed, blunt upper end, a blind bore (not shown) and a lateral hole **52**. The blind bore is fluidly connected to the lateral hole **52**. The end of the needle **50** opposite the lateral hole **52** is connected to the fluid conduit **20** for providing ink to the printhead **14** shown in FIG. **1**. A sliding collar **54** surrounds the needle **50** and is biased upwardly by spring **56**. The sliding collar **54** has a compliant sealing portion with an exposed upper surface and an inner surface in direct contact with the needle **50**.

The air outlet **42** on the ink container receiving station **46** is similar to the fluid inlet **44** except does not include the sliding collar **54** and the spring **56**. The air outlet **42** on the ink container receiving station **46** includes a housing **58** and an outwardly extending needle **60** having a closed, blunt upper end, a blind bore (not shown) and a lateral hole **62**. The blind bore is fluidly connected to the lateral hole **62**. The end of the needle **60** opposite the lateral hole **62** is connected to the air conduit **18** for providing pressurized air to the ink container **12** shown in FIG. **1**.

In this preferred embodiment, the fluid outlet **30** associated with the ink container **12** includes a hollow cylindrical boss **64** that extends outward from an ink container chassis **66**. The end of the boss **64** toward the chassis **66** opens into a conduit **68** which is fluidly connected to the ink reservoir **22** thereby providing fluid to the fluid outlet **30**. A spring **70** and sealing ball **72** are positioned within the boss **64** and held in place by a sealing member such as compliant septum **34** and a crimp cover **74**. The spring **70** biases the sealing ball **72** against the septum **34** to form a fluid seal preventing fluid leakage from the ink container **12** when the ink container is removed from the receiving station **46**. In addition, the sealing member **34** forms a seal to prevent fluid within the ink container **12** from passing between the sealing member **34** and the outwardly extending needle **50** when the ink container **12** is properly inserted into the printer chassis **38**. The sealing member **34** will be discussed in more detail with respect to FIGS. **5–7**.

In the preferred embodiment, the air inlet **28** associated with the ink container **12** is similar to the fluid outlet **30** except that the additional seal formed by the spring **70** and sealing ball **72** are eliminated. The air inlet **28** associated with the ink container **12** includes a hollow cylindrical boss **76** that extends outward from an ink container chassis **68**. The end of the boss **76** toward the chassis **68** opens into a conduit **78** which is in communication with a region between the outer shell **24** and an outer portion of the fluid reservoir **22** for pressurizing the fluid reservoir **22**. The sealing member **36** such as compliant septum and a crimp cover **80** form a seal to prevent pressurized air within the ink container **12** from passing between the sealing member **36**

and the outwardly extending needle **60** when the ink container **12** is properly inserted into the printer chassis **38**.

FIGS. **5** and **6** depict greater detail of the sealing member **34** shown in FIG. **4**. Sealing member **36** is similar to sealing member **34** and therefore will not be discussed in detail. FIG. **5** depicts an end view taken across lines **5**—**5** of the fluid outlet **30** shown in FIG. **3**. The crimp cap **74** is shown positioned on the sealing member **34**. The sealing member **34** includes a slit **82** that is centrally located in the sealing member and extends axially through the sealing member **34**. As shown in FIG. **6**, the slit **82** is tapered from a leading edge **84** to a trailing edge **86** of the sealing member **34**, relative to a direction of insertion into the printer chassis **38**. The crimp cap **74** includes an opening **88** for allowing the blunt end of needle **50** to engage slit **82** and penetrate through the sealing member **34** to accomplish fluid communication between the ink container **12** and the printer chassis **38**.

A lead-in portion **90** is provided at the leading edge **84** of the sealing member **34** to aid in guiding the blunt end of the needle **50** into the slit **82** in the event of needle **50** misalignment during the insertion of the ink container **12** into the printer chassis **38**. In the preferred embodiment, the lead-in portion **90** is concave or bowl-shaped to guide the needle **50** to the slit **82**. The lead-in portion **90** may be a variety of other shapes each of which tend to guide the needle **50** to the slit **82**. In the preferred embodiment a lubricant is disposed within this lead-in portion **90**. The lubricant is a suitable lubricant for reducing friction between the blunt end of the needle **50** and the lead-in portion **90** of the sealing member **34** to minimize or eliminate damage such as ripping or tearing of the sealing member **34** during insertion of the needle **50** through the slit **82**. In the preferred embodiment, the lubricant is poly(ethylene glycol) PEG 400.

The sealing member **34** seals the ink container **12** when the needle **50** is removed from the sealing member **34**. Therefore, it is important that the sealing member **34** be under compression so that the sealing member **34** creep shut to seal the slit **82** in the sealing member **34**. This compression is accomplished by a compressive fit between the sealing member **34** and the crimp cap **74**. In addition, it is important that the sealing member material have sufficient resiliency to spring back quickly to seal the slit **82** such that ink leakage is minimized or eliminated when the ink container **12** is removed from the printer chassis **38**.

The slit **82** in the preferred embodiment is tapered to form a well-defined seal area between the sealing member **34** and the needle **50**. The slit may be a variety of other shapes such as an hourglass shape or some other contour which provides a small sealing area that provides a well controlled contact point between the sealing member **34** and the needle. In addition, it is important that the contour of the slit **82** deflect in a controlled manner as the needle **50** is inserted to provide a well controlled force about the contact point between the sealing member **34** and needle **50** to minimize ink leakage between the needle **50** and the sealing member **34**. Although the embodiment shown in FIG. **5** makes use of a contoured slit to achieve a well controlled sealing surface alternatively the sealing member **34** adjacent the needle **50** can be contoured to form a well controlled sealing surface. For example, a sealing surface adjacent the needle **50** can have an hourglass shaped cross-section that thickens radially from the central axis.

In the preferred embodiment, a secondary seal is provided to eliminate or reduce fluid leakage when the needle **50** is removed from the sealing member **34**. This secondary seal is provided by a sealing member **72** such as a sealing ball that is biased against a complementary shaped sealing surface **92** at the trailing edge **86** of the sealing member **34**. The sealing surface **92** is contoured to provide a well-defined sealing surface with the sealing member **72**. In the preferred embodiment the sealing member **72** is biased towards the sealing surface **92** when the needle **50** is removed from the sealing member **34**. Upon insertion of the needle **50** into the sealing member **34** the blunt end of the needle **50** engages the sealing member **72** and displaces it from the sealing surface **92** allowing fluid to pass between the ink container **12** and the printer chassis **38**.

An important aspect of the sealing member **34** of the present invention is that the sealing member **72** should be spaced from the slit **82**. The spacing between the sealing member **72** and the slit **82** having sealing surfaces is represented by a distance d in FIG. **6**. To Applicant's surprise, if the spacing represented by distance d is not sufficient the sealing member **72** is prevented from properly engaging the sealing surface **92** because of debris dislodged from the slit **82** which prevent the sealing ball **72** from properly engaging the sealing surface **92**. Applicant discovered that repeated insertions and removals of the needle **50** through the slit **82** tends to erode or tear portions of the sealing member **34** which tend to accumulate in the region **94** between the sealing member **72** and the slit **82**. It was discovered that when the spacing represented by distance d between the sealing ball **72** and the slit **82** is insufficient this debris tends to prevent the sealing ball **72** from properly engaging the seal **92** allowing fluid leakage past the secondary seal when the needle **50** is removed. Therefore, it is important that a debris accumulation region **94** be provided that is sufficiently large to allow debris accumulation without interfering with the seating of the sealing member **72** with the sealing surface **92**. The size of the debris accumulation region **94** or distance d that is required will in general depend on the erosion characteristics of the sealing member **34** and the degree of frictional forces between the needle **50** and the sealing member **34** during insertion and removal through slit **82**.

FIG. **7** represents an alternative embodiment of the sealing member **34** shown in FIG. **6**. Similar numbering is used to represent similar structures. The sealing member **34'** shown in FIG. **7** is similar to the sealing member **34** shown in FIG. **6** except for a lead-in **90'** is contoured differently from the lead-in **90** shown in FIG. **6**. The lead-in **90'** is more shallow than the lead-in **90** shown in FIG. **6**. In addition, the sealing surface **92'** at the secondary seal is contoured differently than the more contoured sealing surface **92** shown in FIG. **6**. In addition, this sealing surface **92'** is disposed relative to the slit **82'** such that with the sealing member **72** positioned to engage the sealing surface **92'** a space d' is provided between the slit **82'** and the sealing member **72** to accommodate debris or particles dislodged from the sealing member **34'**.

It is critical that ink leakage from the ink container **12** be reduced or eliminated both when the ink container **12** is inserted into the printer chassis **38** as well as when the ink container **12** is removed from the printer chassis **38**. Ink leakage from the ink container **12** when installed in the printer chassis **38** can damage the printer. In addition, ink leakage during storage and transportation of the ink container **12** is unacceptable for the printer user.

What is claimed is:

1. An ink container for providing ink to an ink jet printing system, the ink container having a fluid outlet for fluidically communicating with a fluid inlet of the ink jet printing system, the fluid inlet having a hollow needle having a blunt end and a lateral hole, the ink container including:

a resilient body member at the fluid outlet, the resilient body member including:

a first sealing surface for tightly receiving the hollow needle to prevent fluid passage between an outer surface of the hollow needle and the first sealing surface when the ink container is in fluid communication with the ink jet printing system, the first sealing surface having a leading edge and a trailing edge relative to a direction of insertion of the hollow tubular member into the first sealing surface;

a second sealing surface for receiving a movable sealing member, wherein the movable sealing member is biased against the second sealing surface when the hollow needle is at least partially removed from the first sealing surface; and

a debris accumulation region at the trailing edge of the first sealing surface, wherein the debris accumulation region sufficiently spaces the second sealing surface and thereby the movable sealing member from the trailing edge of the first sealing surface so that the movable sealing member does not contact the trailing edge of the first sealing surface and debris resulting from movement of the hollow needle relative to the first sealing surface accumulates within the debris accumulation region and does not prevent the movable sealing member from seating with the second sealing surface.

2. The ink container of claim **1** wherein the first sealing surface is a preformed slit in the resilient body member.

3. The ink container of claim **1** wherein the leading edge of the first sealing surface includes a concave shaped lead-in portion for guiding the blunt end of the hollow needle toward the first sealing surface during insertion of the hollow needle into the first sealing surface.

4. The ink container of claim **3** wherein the concave shaped lead-in portion contains a lubricant to reduce friction between the hollow needle and the first sealing surface during insertion of the hollow needle through the first sealing surface.

5. The ink container of claim **1** wherein the movable sealing member is spherical and wherein the second sealing surface has a shape that is complementary to the movable sealing member.

6. The ink container of claim **1** wherein the ink container fluid outlet has a central axis and wherein each of the first and second sealing surfaces are disposed along the central axis.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,299,296 B2
DATED : October 9, 2001
INVENTOR(S) : Eric L. Gasvoda

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [56], **References Cited**, U.S. PATENT DOCUMENTS, reference was inadvertently omitted. Please insert
-- 5,135,489 8/1992 Jepson et al.....604/48 --;
FOREIGN PATENT DOCUMENTS, reference was inadvertently omitted. Please insert -- G 94 05 723.0 7/1994 (DE)..... --;

Signed and Sealed this

Seventeenth Day of September, 2002

Attest:

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

Attesting Officer